Installation of Corrosion Control Solutions During System RESET

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Background

- Corrosion of ground weapon systems results in significant monetary costs
  - LMI Army Cost of Corrosion Report - $2B annually
  - LMI USMC Cost of Corrosion Report - $0.7B annually
- Some vehicles, such as legacy systems may be pre-disposed to corrosion
- For modern weapon systems exposure to corrosive environments and / or repair may reduce the corrosion control systems
- Upgrade or restoration of the corrosion control systems is needed

OSD Project Overview

- Incorporating proven and commercially available corrosion control technologies
- Leveraging the opportunities system RESET affords us
- Working with the PMs, OEMs and organizations performing RESET activities
- Demonstrating appropriate technologies for the weapon system
- Determining the ROI of the installation

Why Upgrading During RESET Makes Sense

- RESET provides an ideal opportunity to insert corrosion control technologies
- Weapon systems are typically largely disassembled to facilitate repair
- Worn out / broken components are repaired
- Complete coating removal and reapplication is already planned
- Facilities already have equipment and skilled workers to perform these activities

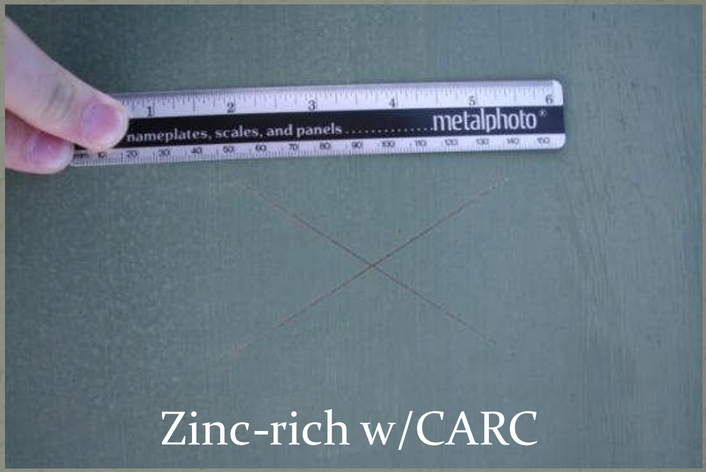
Technology Examples

- Paints and coatings
  - Zinc-rich
  - High-build polyurethane
- Plating and metalizing
  - Zinc and aluminum alloys
  - High purity non-aqueous aluminum plating
- Part replacement
  - Corrosion resistant parts
  - Non-metallic components
  - Part upgrade (e.g., galvanized body panels)

Technology Example – High Build Polyurethane Coating

Demonstrated Benefits – Zinc-rich Coatings

- Widespread use on infrastructure elements (e.g., bridges and highways)
- Used on modern weapon systems (e.g., USMC MTVR)
- Past Army project demonstrated benefit
  - 7-years in marine environment
  - Compared to traditional CARC system over steel
  - Negligible deterioration of zinc-rich material



Zinc-rich w/CARC

CARC only

Demonstrated Benefits – Non-aqueous Electroplated Aluminum

- Potential drop-in replacement for Cadmium
- Does not demonstrate hydrogen embrittlement / environmentally assisted cracking issues
- Able to match torque / tension requirements for Cadmium (with dry-film lubricant)
- Performs well with trivalent chrome rinse
- Technology used by
  - Joint Strike Fighter (JSF)
  - BMW, VW and Volvo in automotive applications

Demonstrated Benefits – Galvanized Body Panels

- Galvanized sheet steel is commonly used in commercial automotive applications
- Manufacturing components out of galvanized steel is readily accomplished
- Modern Example
  - FMTV vehicles originally used carbon steel on cabs and experienced corrosion issues
  - Subsequent cabs were upgraded to galvanized steel with no reported issues

- On body panels (like doors) corrosion often occurs along the bottom seam
  - Collection point for contaminants
  - No drainage / ability to clean out contaminants

First Platform – Stryker

Non-aqueous Electroplated Aluminum

- Majority of Cadmium replaced
- Hex-chrome rinse still being used
- Some components still use Cadmium
- Looking toward material as a single, drop-in replacement

High Build Polyurethane

- Concerns exist in wheel areas
- High impact area where coating loss can progress
- Once voids occur corrosion can progress rapidly
- Considering chip-resistant materials for this application

Other Platforms

- HMMWV
  - Review of past corrosion inspection data has identified several potential issues
  - Battery areas and hold-down brackets
  - Reflectors
  - Latches, guides and brackets
  - Material changes or coatings can improve these areas
- Engineering Equipment
  - Working with PMs to identify opportunities
  - Typically these are bought to commercial standards
  - Opportunities for the use of zinc-rich coatings on steel components

Other Platforms (cont'd)

- Trailers
  - Cargo beds known to be corrosion prone
  - Typically thin-gage sheet steel with CARC coating
  - Coating easily removed with normal installation / removal of cargo
  - Use of chip-resistant materials can reduce this damage and protect both the substrate and CARC coating
- MRAP vehicles
  - Rapid procurement resulted in less stringent corrosion control requirements / enforcement
  - Add-on components (e.g., water can brackets, antenna mounts, etc.) are typically carbon steel
  - Opportunity to improve performance with zinc-rich coating and / or replacements
  - Reviewing use of Cadmium on systems for elimination

Cross-platform Initiative

- Single-source Cadmium replacement
  - Pending outcome of most recent test results, favoring non-aqueous electroplated aluminum
  - Provides similar or better performance than Cadmium
  - Working with DLA to determine how to most readily get this into the system
  - Eliminate the need to specify system-unique requirements
  - Eliminate recontamination of the system during maintenance

Status of Initiatives

- Non-aqueous electroplated aluminum
  - Review of technical literature near completion
  - Results of current testing expected in next 1-2 months
  - Samples being prepared for Stryker demonstration
- High-build polyurethane coatings
  - Recent work by USMC being considered for implementation
  - During Stryker demonstration review systems for coating demonstration
  - Review of USMC trailer test cases planned

Status of Initiatives (cont'd)

- HMMWV
  - Data analysis complete
  - Meeting planned with PM to discuss opportunities and solutions
  - Identify best solutions for implementation and move forward with demonstration
- Engineering Equipment
  - Briefed PM on solutions sets
  - Working with them on identification of specific opportunities and test systems
- Cross-platform initiative
  - Participating in DoD efforts on Cadmium and Hex-chrome elimination
  - Drafting position letter to be issued by TACOM / TARDEC

Current Schedule

- Winter / Spring 2009
  - Stryker demonstrations
  - Polyurethane evaluations
  - Meeting with PM HMMWV and identify demonstration opportunities
  - Follow-up with PM Engineering Equipment
- Spring / Summer 2009
  - Complete all demonstrations
  - Revisit Stryker for evaluation of technologies
  - Compile application data for development of work instructions and ROI analysis
- Fall 2009
  - Final report on technologies investigated
  - Final maintenance instructions
  - Develop plan for future investigations and ROI validation